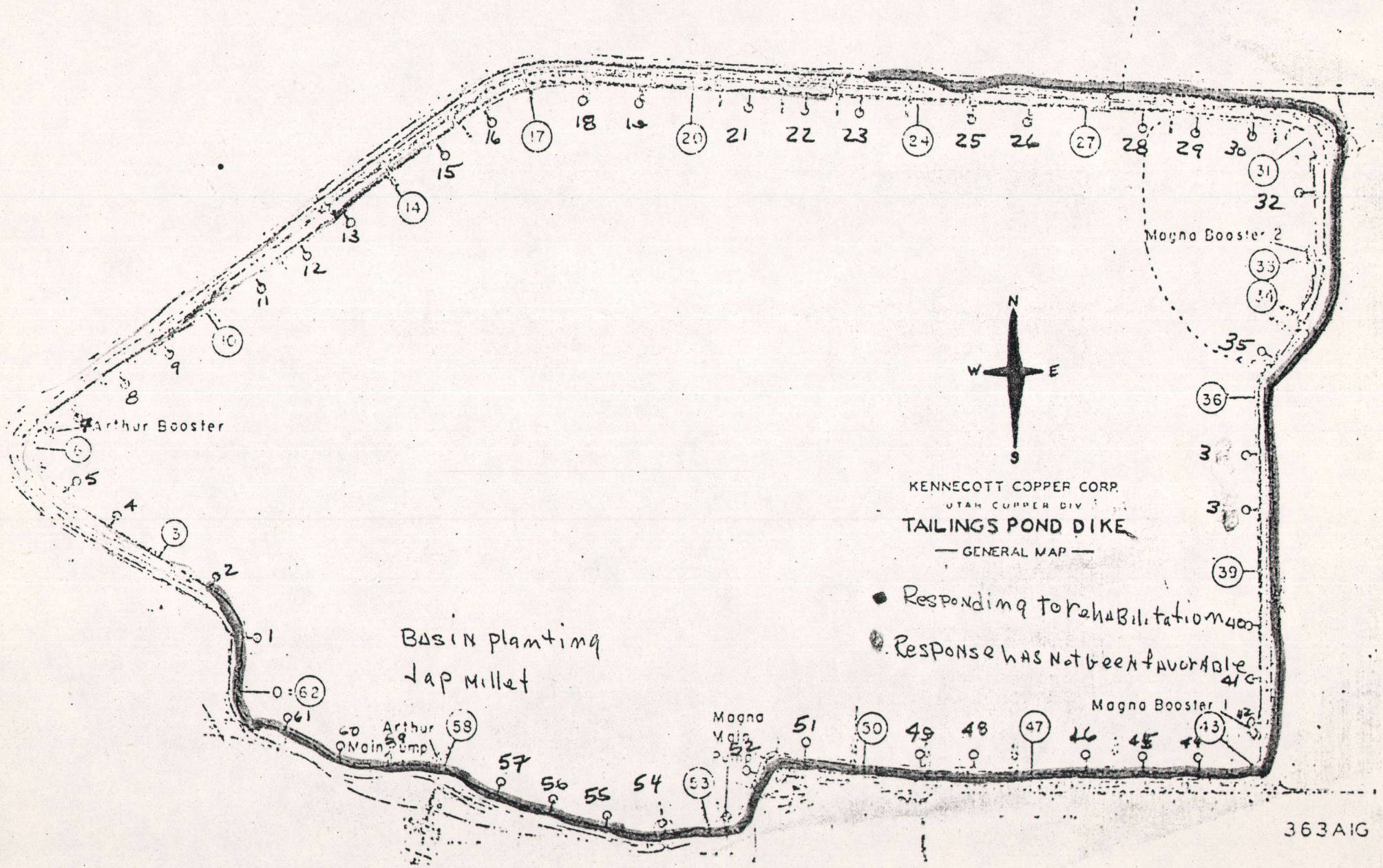
TAILING POND

April 18, 1977

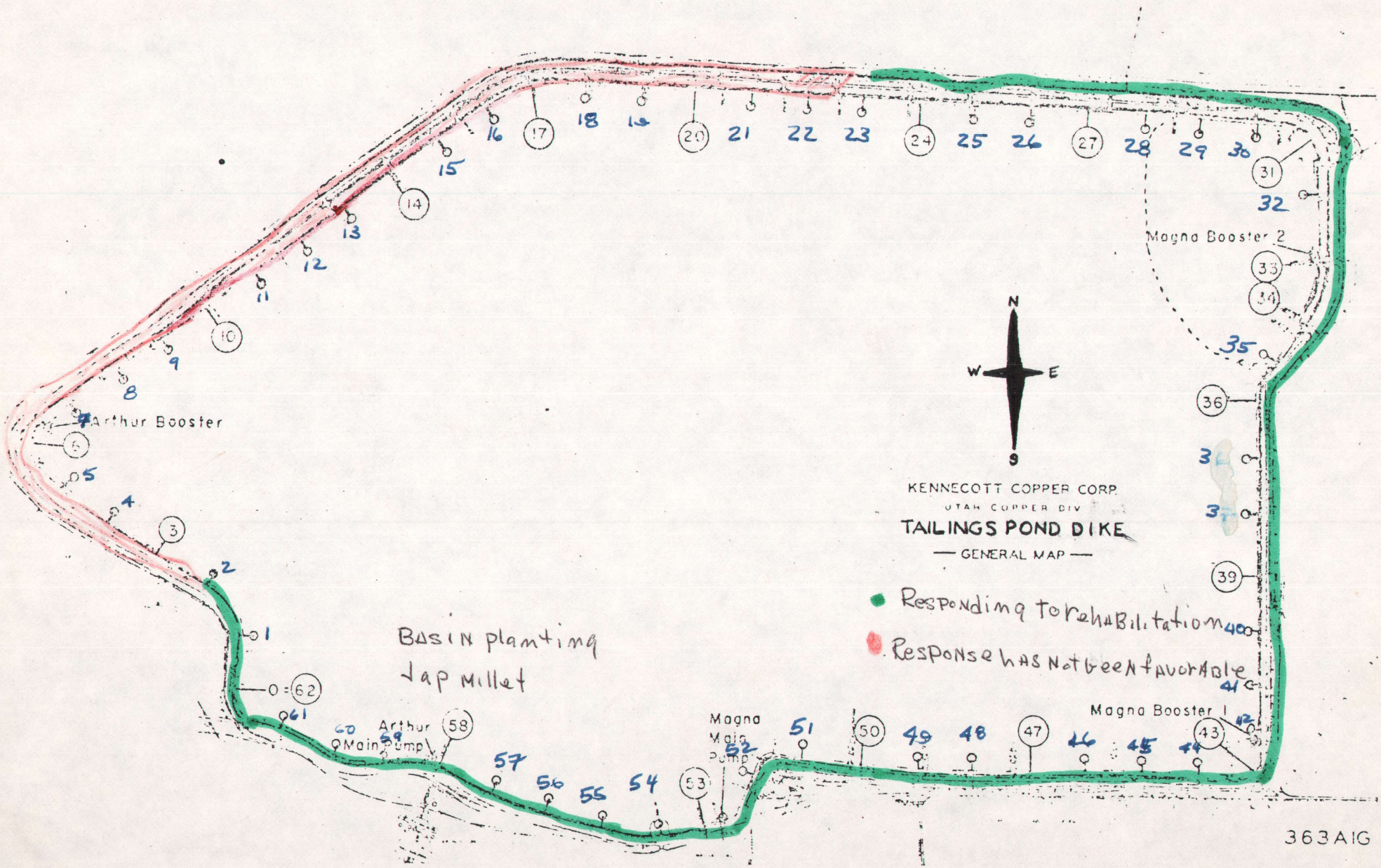
Total area	6,000 acres.
Current surface area	4,800 acres.
Present dike height	North 56 ft., East 116 ft., South 136 ft., West 111 ft.
Perimeter distance	12 miles.
Slope of dike	1 vertical to 5 horizontal.
Slope of tailing deposition	About .003 ft. per ft.
Current tailing deposition	About 100,000 tons per day.
Current rate of increase of pond surface elevation	About 3-1/2 ft. per year.



U.C.d Revegetation

Program

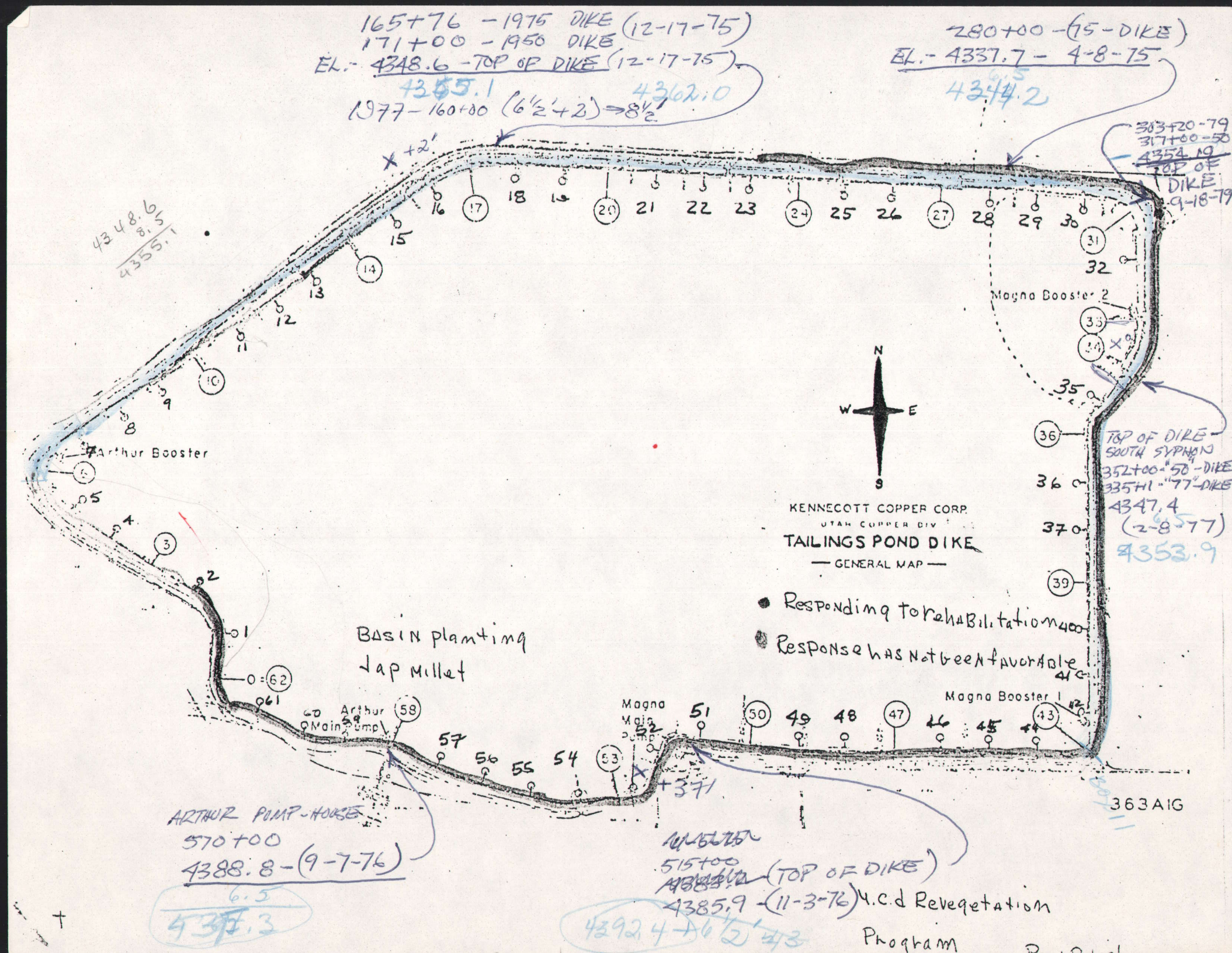
Paul Patrick



4.c.d Revegetation

Program

Paul Rotich


165+76 - 1975 DIKE (12-17-75)
171+00 - 1950 DIKE
EL.- 4348.6 - TOP OF DIKE (12-17-75)
4355.1
4362.0
1977 - 160+00 (6½'+2') → 8½'
280+00 - (75 - DIKE)
EL.- 4337.7 - 4-8-75
4344.2
303+20 - 79
317+00 - 50
4354.19
TOP OF DIKE
9-18-79
4348.6
8.5
4355.1
+2'
Arthur Booster
Magna Booster 2
Magna Booster 1
Arthur Main Pump
Magna Main Pump
N
W
E
S
KENNECOTT COPPER CORP.
UTAH COPPER DIV.
TAILINGS POND DIKE
— GENERAL MAP —
TOP OF DIKE - SOUTH SYPHON
352+00 - "50" - DIKE
335+11 - "77" - DIKE
4347.4
(2-8-77)
4353.9
• Responding to rehabilitation
• Response has not been favorable
Basin planting
Jap Millet
+371
363AIG
ARTHUR PUMP-HOUSE
570+00
4388.8 - (9-7-76)
6.5
4355.3
515+00
4385.9 - (11-3-76) (TOP OF DIKE)
4.c.d Revegetation
Program
4292.4 + 6½' = 43

303+20 (1979) 9-18-79

STATION	HORIZONTAL ANGLE	BEARING	MAGNETIC BEARING	SLOPE OR STADIA DISTANCE	VERTICAL ANGLE	HORIZONTAL DISTANCE	HI 5.0	VERTICAL DISTANCE	ELEVATION	
1950 317+00									4354.19	TOP OF 19 DIKE 1.0' FROM OUTSIDE EDGE
	IN					35.0		-8.8	45.4	INSIDE TOE
	IN					20.0		-0.3	53.9	INSIDE EDGE
	OUT					1.0		0.0	54.2	OUTSIDE EDGE
	OUT					14.0		-12.4	41.8	OUTSIDE TOE
	OUT					36.0		-10.2	44.0	BREAK
	OUT			41.0	104°29'	39.7		-10.3	43.9	" "
	✓			90.0	100°29'	88.5		-16.4	37.8	" ✓
	✓			112.0	98°52'	110.7		-17.3	36.9	TOP OF PIEZO -.2' TO GRD
	✓			242.0	98°19	239.5		-35.0	4319.19	TOP OF "B" PIN -1.1' TO GRD
	✓			384.0	97°10'	381.0	-8'	-47.9	4298.29	TOP OF 2ND PIEZO
	✓			410.0	96°46'	407.1	-8'	-48.3	4297.88	TOP OF "A" PIN

TAILING POND

The tailing product from the ore concentrators is discharged as a slurry into a tailing pond having an area of approximately 6,000 acres. The pond is immediately north of the concentrators in Salt Lake County and includes roughly ~~See~~ 10 Sections in T 1 S & R 2 & 3W ? and present average elevation is 4345 .

This total area has been used for the tailing pond since approximately 1916 and with current tailing disposal practice it is anticipated that the same area will continue in use for the life of the mining property.

A dike extends completely around the perimeter of the pond. Initially dike fill was rock waste from the mine, later ~~it was~~ hauled fill from areas adjacent to the concentrator plants, was used and more recently dike build up is being accomplished by ~~reclamation~~ relocation of previously ~~deposited~~ placed dike fill material by dragline. This is followed by sealing of the pond side of the dike with a berm of coarse tailing distributed by a perimeter pumping system. To obtain adequate dike stability, the outside ~~slope~~ of the dike is maintained at 5 to 1 ~~ratio~~ slope as recommended ~~following studies~~ by consultants on slope stability. Periodic inspections are conducted by the consultants to assure long range stability of the system. (Add something on testing methods, etc. used) (*) Piezometers Para. Methods of Test for

Dewatering of the tailing pond is by means of two buoy-supported siphon lines which remove clear water, most of which is reclaimed as concentrator process water.

~~To maintain a stable condition on the outside slope of the dike, the surface slope is constructed at 5 to 1.~~ The area near the top of the dike which is subject to being disturbed in the subsequent dike build up, and roads on the dike, are stabilized for wind erosion control by frequent application of a soil stabilizing agent, Coherex. Farther down the outside slope where the surface is permanent, revegetation is practiced. ~~Soil~~ Experts continually conduct studies to develop a plant community which will thrive and result in ecological conditions compatible with local environment. Current plantings include several grass and tree species along the dike slopes. The early stages of the

planting program on the dike slopes have produced encouraging results and the more extensive programs currently being pursued are expected to have a high degree of success.

The surface of the tailing pond rises approximately three feet per year during normal operation, therefore permanent stabilization or revegetation of the pond surface is not possible as long as operation continues. However, wind erosion control is practiced. About 90% of the pond surface is moist at all times by the natural meandering of the tailing stream discharged into the pond. The remaining areas are treated by several different methods to stabilize the surface. Where possible, the surface is wetted by 20-inch tailing distribution lines installed for this purpose. If this is not feasible and the dry areas are accessible to automotive type vehicles, the surface is treated with Coherex. If not accessible by land vehicles, dry areas are treated by application of a polymer product with aircraft. Use of fast growing grasses is also being investigated for wind erosion control.

Efforts are also being directed at utilization of the tailing material as produced. Major tests have demonstrated that coarse tailing is an excellent fill material for highway construction and other construction projects requiring fill. It has also been demonstrated that mixing of tailing with some of the highly alkaline soils in the area results in a soil which promotes excellent growth.

Date of cessation of mining operations is indeterminate at this time because of the many variables involved, including economic conditions. However, if for the purpose of this application, a life of 50 years from the current date is assumed, and operation continues at the current rate, the tailing pond surface area at that time will be approximately 3,000 acres.

At that time grading ~~dressing~~ and revegetation of dike slopes not already done will be completed. Essential access roads on the dike slopes and top of the dike will be coated with Coherex or other suitable surface stabilzing agent to prevent wind erosion.

In its terminal condition, the tailing pond may be considered as a resource. It will be a unique area of real estate for some ultimate purpose, and several alternates may be considered depending on conditions at the time of cessation of operations. First, the tailing pond has potential of being a mineral resource of considerable value when mineral recovery techniques are improved and economic conditions justify consideration of reprocessing the pond material.

Pond material also has value as fill for land reclamation in other areas of the Salt Lake Valley as illustrated by current usages in highway embankment work and fill on other construction projects. Study by ~~acid~~ experts has also demonstrated, as noted previously that tailing pond material may be mixed with alkali soils resulting in a greatly improved soil which will sustain a wide range of vegetation.

Another important alternate is utilization of the pond area as real estate. As a relatively flat area of 3,000 acres with an average elevation of 4560' (airport), it will have potential for industrial sites or agricultural use. Initially the surface could be stabilized by application of Coherex. (Current cost of such treatment is approximately $200 per acre.) This treatment will provide a stabilized surface until final use is implemented.

Revegetation is also receiving consideration for stabilization and subsequent reclamation of the tailing pond surface. To this end an extensive program is being supported to ascertain which species of vegetation are suitable and procedures required to obtain adequate vegetation growth.

(1976 / 2007) Ave 4.0 x 31 = 124

(2007 / 2020) Ave. 5.0 x 12 = 60

(2020 / 2027) Ave 6.0 x 6 = 36

220

Elev. will be 4345 + 215 = 4560

CHAPTER III

TAILINGS DISPOSAL SYSTEM AND METHODS

A. PRESENT METHOD OF DISPOSAL

The tailings materials from the Arthur and Magna concentrators enter the disposal pond in a slurry containing 28-30 percent solids from two points on the southern edge of the deposit. These discharge points, opposite each concentration plant, are about one mile apart. Most of the material falls on the surface of the deposit at the rate of about 108,000 dry tons per day and flows into the reservoir, the coarser grains settling out close to the southern edge and the finer grains close to the northern edge. In 1960, a peripheral discharge system was developed consisting of a pipe on the crest of the dike; the pipe encloses the whole deposit. Tailings material is pumped into the pipe from pumping stations located at the south edge at sufficiently high pressure to carry the slurry around the approximately 12-mile long perimeter of the deposit. Holes spaced at regular intervals on this pipe permit tailings to flow into the reservoir immediately behind the crest of the dike (Photoplate I-A). The peripheral discharge is an intermittent operation employed to produce a beaching action whereby the sandier portion of the tailings settle close to the dike, thus providing a positive drainage gradient into the pond area. This also prevents decant water from reaching and eroding the inside toe of the dike.

The tailings are being distributed in the reservoir in such a way as to force the formation of a decant water pond in the northeastern corner of the deposit. A system of siphons there (Photoplate I-B) reclaims the water which is then conveyed through a 54-inch diameter wood stave pipe to the vicinity of the Magna concentrator. Part of the water is pumped back to the concentration circuit when needed and the rest is released into the natural drainage at Magna or into irrigation canals. The maximum water-handling capacity of the concentrator is about 30,000 gpm of water reclaimed from the pond. Since water enters the deposit at a rate of about 42,000 gpm, there are about 12,000 gpm which are available for infiltration and evaporation losses and disposal into the irrigation or waste canal system. The perimeter dike which contains the tailings material has been built since 1971 with a dragline. This equipment operates from the crest of the dike and is used to excavate the top of the previous lower dike (Photoplate II-A). The excavated material is then placed partially on top of the crest of the dike and partially on top of the tailings (Photoplate II-B). Afterwards, a dozer spreads it and passes over it for compaction. The average yearly raise of the crest is 3.5 feet. The overall average outside slope on the northern side of the tailings deposit is presently maintained at about 5 horizontal to 1 vertical. Each successive dike, however, has slopes of about 1 to 1.5 horizontal to 1 vertical. The average elevation of the crest of the dike in mid-1972 was about 4,340 feet.

B. PAST METHODS OF DISPOSAL

The change of disposal practices through the years reflect in part the change in production from the concentrators and also the problems experienced with previous methods of tailings disposal. Since the early part of this century, tailings have been deposited in the present Magna tailings pond area. The flotation method now in use to concentrate ore was started in 1920 and the rate of tailings deposited yearly increased from 90,000 tons/day before 1966 to the present 108,000 tons/day.

1. Before 1952

The first dike to impound tailings was built around 1918 and consisted of waste rock from the mine. This waste rock was hauled in by railroad and dumped in a series of progressively higher levees. The dike's ultimate crest is represented now by the wide access road, approximately at Elevation 4250, about 35 feet above natural ground. Tailings entered the reservoir from the south side only, as there was no provision for peripheral discharge of tailings. Several failures occurred on the dike which caused serious damage to the hauling equipment.

To prevent more problems with the original dike, a new dike was started around 1945. This dike, referred to as the "1950 dike" by Kennecott, was started about 50 feet from the inside edge of the crest of the previous rockfill dike and had an exterior slope of 1.5 horizontal to 1 vertical. The materials used were gravel-size mine waste hauled in by truck and dumped directly on the tailings that had been ponded by the original dike. Gravel was dumped until the soft tailings foundation did not yield any more and enough resistance was developed. The dike was raised by this method to a crest elevation of 4,275, about 25 feet above the crest of the original rockfill dike.

2. Between 1952 and 1970

A third dike was started in 1952, about 150 feet from the inside edge of the crest of the previous one. This dike was also built by dumping gravel from trucks and building small dikes, about 8 to 15 feet high, which overlapped each previous dike's crest and the tailings (Photoplate III-A). The downstream faces of each of these dikes had slopes that varied between about 1.5:1 and 2.5:1. The overall average slope between the toe of this dike and the crest elevation of 4,335 corresponding to the year 1970 is about 3.5:1 (horizontal to vertical).